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ABSTRACT

Research investigated the relative contributions of team competition and peer group practice sessions to the effectiveness of a classroom instructional technique known as Teams-Games Tournament. Eight mathematics classes with 240 seventh grade students participated in a ten-week field experiment. A 2x2 design was employed. The factors were (1) reward system (team competition versus individual competition) and (2) practice (group practice versus individual practice). Students participated in 12 game tournaments with competition centered on a modified version of the math game "Tuf". A significant reward main effect and two significant interaction effects were obtained for the Arithmetic Computation subtest of the Stanford Achievement Test. High and low performers in the team condition improved significantly more than students in the individual reward group. Group practice had no significant effect on their level of achievement, but did benefit the low performer in the individual reward group at the expense of the high performer. It was concluded that games can be effective instructional devices for increasing academic achievement and that their success as instructional aids varies with the reward systems and practice structures under which students operate. (Author)

GAMES AND TEAMS: AN EFFECTIVE COMBINATION IN THE CLASSROOM

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Abstract

A study was conducted to determine the relative contribution of team competition and peer group practice sessions to the effectiveness of a classroom instructional technique known as Teams-Games-Tournament (TGT). Two hundred and forty (240) seventh grade students in eight mathematics classes participated in a ten week field experiment. A 2 X 2 design was employed. The factors were (1) Reward System (Team Competition vs. Individual Competition) and (2) Practice (Group Practice vs. Individual Practice). Students participated in twelve game tournaments with competition centered on a modified version of the math game Tuf.

A significant reward main effect and two significant interaction effects were obtained for the Arithmetic Computation subtest of the Stanford Achievement Test (SAT). High and low performers in the Team condition improved significantly more on the SAT than students in the Individual Reward group. Group Practice had no significant effect on their level of achievement. Group Practice benefited the low performer in the Individual Reward group at the expense of the high performer. An expectancy value theory of student motivation was used to interpret the results.

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GAMES AND TEAMS: AN EFFECTIVE COMBINATION IN THE CLASSROOM

Introduction

Most advocates of the use of games in the classroom have focused their attention on the merits of simulation games. Unfortunately, the development of simulation games has not yet extended to all curriculum areas. Arithmetic computation is a case in point. In such a situation the non-simulation game may prove to be a viable alternative.

Non-simulation games have been in classroom use for some time particularly as emergency devices for prolonging the attention span of uninterested students. Since this use of games is quite peripheral to the learning process, it is not surprising that little attempt has been made to test the effectiveness of the non-simulation game as a legitimate instructional technique. Recently, however their potential role as facilitators in the learning process has been recognized. (Allen, 1970; Edwards, et al., 1972).

Non-simulation games are based directly on knowledge of subject-matter content. Thus winning necessitates learning. Non-simulation games also retain some of the advantages of the simulation game. That is, they have an intrinsic appeal based upon the game rules and the uncertainty of the outcome. For many students winning at a game constitutes a more highly valued and concrete goal than does receiving high grades or teacher approval. Also, since game-playing necessarily results in losers as well as in winners, losing at a game entails less negative evaluation than low grades on a traditional classroom activity (Boocock & Schild, 1968).

Unfortunately, games themselves cannot change the basic facts of classroom life. It is more likely that a high achieving student will be a game winner even though the game situation may initially alter the incentive value which low achieving students attach to academic progress. As Jerome Kagan (1974) notes: "...individuals will cease investing effort in a problem if they ... have no expectation of success." It is thus necessary to imbed the non-simulation game in a classroom structure which supports its positive attributes rather than detracting from them.

It has been recommended (Allen, 1970; Abt, 1968), for example, that game-playing groups consist of evenly matched players. Competition among student teams has been advocated (Coleman, 1959; Spilerman, 1971) as a means of altering the normative climate in the classroom. The individual reward structure typically found in the conventional classroom, at best leaves pupils indifferent to the academic achievement of their peers, and at worst, leads to the establishment of group norms which seek to hold down the level of achievement of high performing students. Team affiliation is presumed to counter this tendency by providing students with a reason to support and encourage the academic efforts of their teammates.

TEAMS-GAMES-TOURNAMENT (TGT)

Researchers at The Johns Hopkins University, namely, David DeVries, and Keith Edwards, have been working with a classroom structure which seeks to maximize the impact of non-simulation games on academic achievement and pupil attitudes toward school, classmates, and course content. The Teams-Games-Tournament technique, known as TGT, restructures the classroom learning environment in the following ways: (1) pupils are assigned to four-person

teams such that high, low and middle achieving students are represented. This procedure serves to maximize the academic resources within each team. Team membership is also balanced in terms of sex and ethnic background; (2) pupils play an instructional game which requires them to use knowledge taught during regular classroom periods; (3) tournaments are held at least once a week. Each team member is assigned to a game table where he competes against two representatives of other teams whose level of achievement is comparable to his own. Note that team members do not play together.

This tournament structure serves to maintain the individual accountability and individual feedback necessary for academic progress. It also serves to equalize the probability of being a game winner across all ability levels in the class. At the end of every tournament (usually one class period) the high scorer at each game table contributes six points to his team's score; the middle scorer contributes four points; the low scorer at each table contributes two points. Team standings are reported in the form of a newsletter following each tournament. In between tournaments, team practice sessions are scheduled to allow teammates to review relevant material and engage in peer tutoring when necessary. DeVries, et al., (1973) describes in greater detail how TGT is implemented in the classroom.

Research comparing TGT with a control group (Edwards, et al., 1972) indicated that the Teams-Games-Tournament is an effective technique for increasing student academic achievement. Other studies (Edwards & DeVries, 1972; DeVries, et al., 1974) indicated positive effects on student attitudes and classroom process variables. The purpose of the present study was to expand these findings by exploring the structural features of TGT which

appear to account for its effectiveness. Specifically, we sought to estimate the relative contribution of team competition and peer group practice sessions to the effectiveness of the Teams-Games-Tournament technique.

Theoretical Framework

Variations in student achievement have been attributed to many different factors, e.g., educational level of parents, innate ability as measured by I.Q. tests. Of particular interest to us is the role of student motivation in the learning process, i.e., the willingness of a student to put forth the effort needed to learn something new.

A number of motivational models of behavior (Lewin, et al., 1944; Tolman, 1955; Edwards, 1954, 1955; Rotter, 1964; Atkinson, 1966) belong to a class of expectancy value theories. In this view, motivation, as expressed in the direction, magnitude and persistence of behavior, is a function of two situational variables: perceived probability of success and incentive value of success (Feather, 1966, P. 64). Thus, the potentiality that a given behavior or set of behaviors will occur in some specific situation (task attentiveness, for example) is dependent upon (1) an individual's expectancy that the behavior will lead to a particular goal (such as being a game winner or receiving a high grade), and (2) the expected value that goal has for him (Rotter, 1964, P. 60).

It is hypothesized that the tournament component of TGT alters a student's perceived probability of success. In the conventional classroom the performance of low achievers is compared to the performance of high achievers. As a result, differential rates of progress within each group are often not recognized. Low achievers must evidence large

increases in their level of performance before they are rewarded for academic progress. Consequently, their perceived probability of success is relatively low. High performers, on the other hand, tend to receive high grades and teacher approval even though they, too, differ in their rates of progress. The tournament structure provides students with a reward system which is responsive to changes in level of performance by all members of the class. In terms of expectancy of success, the low performer at a game table has the same one-third probability of winning the game as does the high performer at his table. Recall that players are assigned to game tables on the basis of comparable levels of achievement.

The team component of TGT is presumed to affect the incentive value or importance which pupils attach to success at the game. Since team standing is based on the sum of the scores of the individual members (awarded at separate game tables), there is a high degree of reward interdependence among teammates. The expected result is an identification with the team and an acceptance of group goals. Pupils not only work to obtain rewards for themselves, but to obtain rewards for their teammates and from their teammates (Hammond & Goldman, 1961). Reward interdependence is presumed to have another effect as well. Individual pupils may or may not respond to the game-team situation by attaching a high incentive value to game success. Nevertheless, it is expected that team members will experience peer pressure to do well at the game (cf. DeVries, et al., 1971, 1974).

Low motivation may not be the only reason that many students continue to do poorly. Differences in level of student achievement may also be due to differences in the need for individual instruction. The peer tutoring component of TGT may fulfill this need since the team practice session was designed to provide pupils with an additional opportunity for acquiring necessary academic skills. Consequently, the impact of the peer tutoring component on academic achievement is assessed in the present study.

The hypothesized motivational and instructional effects of the team and peer tutoring components of the Teams-Games-Tournament technique are presumed to be particularly beneficial to the lower achieving student. By definition, the high performer has been able to achieve academic success within the conventional classroom structure. The low performer has not. TGT is presumed to alter the instructional environment in ways that particularly affect the learning process of the lower achieving student without causing a decrement in the performance of the high achiever.

Method

Subjects

A ten week field experiment was conducted during the Spring of 1973 at a middle school in a blue collar suburb of Baltimore. Two hundred and forty (240) seventh grade students in eight mathematics classes and two female teachers participated in the experiment.

Experimental Design

A 2 X 2 design was employed. The factors were: (1) Reward System (Individual Competition vs. Team Competition) and (2) Practice (Individual Practice vs. Group Practice). Two classes taught by the same teacher were assigned to each cell. Since the classes represented intact groups, random assignment of classes rather than random assignment of pupils was employed.

Experimental Treatments

Students in the Individual Competition group participated in game-playing tournaments as did their counterparts in the Team condition. However, instead of playing as representatives of a team, students in this group represented only themselves. They received newsletters which listed their latest tournament score (six, four or two), and ranked them according to their individual season record (the sum of all previous scores). Table winners were given special recognition. Students in the Team Competition group also received newsletters which listed the scores they received at the game tables. However, their newsletters put greater emphasis on the team score for the tournament (that is, the sum of the scores of the team members), and the team's season record (the sum of the team's scores including all previous tournaments).

The peer tutoring component of TGT was also manipulated. Students in the Individual Practice group were not permitted to help each other with classwork assignments. Although team members sat together, they were not permitted to peer tutor. Students participating in Group Practice sessions were encouraged to work with others on classwork assignments.

Group Practice sessions provided teammates with the opportunity to assess each other's work and provide help when necessary. Students not assigned to teams, i.e., those in the Individual Reward/Group Practice condition were encouraged to work with students sitting close to them.

Academic Task

Since the study was conducted during the last three months of the school year, a curriculum unit was selected which reviewed material previously taught. This material included addition, subtraction, multiplication and division of whole numbers, fractions and decimals. To meet the goals of the review unit, a modified version of the math game Tuf (Avalon-Hill Company, Baltimore, Md.) was used. The game task consisted of combining numbers and operations in an equation to equal a specified number goal. Pupils at each game table were given a set of multi-colored cubes with a number (0 through 9) or an operation sign (+, -, X, ÷) on each face. The players at each table selected a Puzzle Problem from a list on the blackboard, and arranged their cubes to match the goal and resources (that is, numbers and operations) specified. Each round of the game consisted of arranging as many resources as possible to equal the stated goal. To make the task more game-like, points were awarded on the basis of the length of each equation. One point was awarded for every resource used. Pupils at each game table defended their solution, and were awarded points if the solution was judged correct.

The Puzzle Problem game presented the student with a group-independent task. It was a group task because each player at the gam table had to participate for the game to proceed. It was an independent task because each player had the same resources and goal. Consequently, the length and character of one pupil's solution was not influenced by the solution of his competitors. Competition was based solely on the complexity of each equation. At the end of the round, players checked their solutions and received a number score. Feedback was immediate. Visibility of performance was high. In addition, the task was open-ended. The designated resources allowed players to make simple as well as very complex solutions. As a result, each player was able to adjust the task to his own level of competence.

The Puzzle Problem game has been described in detail because the game is at the heart of the experiment. AGT was designed to provide a structure for the implementation of games in the classroom. However, if the game is weak and its ties to the curriculum tenuous, then its effect on computational skills will be minimal no matter how it is implemented.

Dependent Variables

To measure computational skills, pretest and posttest scores were obtained on the Arithmetic Computation subtest of the Stanford Achievement Test (SAT). Standardized tests have the advantage of providing achievement norms so that student progress can be measured in terms of grade equivalents.

A treatment-specific student self-report measure was also administered prior to completion of the study. Eighteen Likert-type questions assessed student perceptions on four dimensions: (1) perceived probability of success at the game (e.g., it is tough to win the puzzle problem game); (2) incentive value of success (e.g., it does not matter to me if I win or lose at the puzzle problem game); (3) peer pressure to do well at the game (e.g., other students think it is important for me to work hard in the puzzle proglem game); and (4) satisfaction with the game (e.g., I look forward to playing the puzzle proglem game).

Results

Table 1 presents a summary of the results of the analyses performed on all dependent variables. A general multiple linear regression model was employed (Cohen, 1968; Walberg, 1971). F-tests were performed on the incremental R^2 associated with each additional independent variable as described by Cohen (1968). Independent variables were entered into the regression equation in a predetermined order: covariates first, treatment variables next, and interaction effects last. Note that the pretest score on the SAT and the class ability factor were entered first so that their influence on the dependent variables was partialed out prior to the analysis of the effects of the treatment variables.

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Math Achievement

The significant Reward main effect ($F = 5.64$; $df = 1,225$; $P < .05$) is due to a significantly greater improvement on the SAT by students in the Team Competition group than students in the Individual Reward group. In terms of grade equivalents, the mean gain score for students in the Team condition was .7 of a year whereas the mean gain score for students in the Individual Reward condition was .4 of a year. Note that these results were obtained with a three month (.3 of a year) review unit. No new material was taught.

Contrary to prediction, neither a Practice main effect nor a Reward X Practice interaction effect was obtained for the SAT. The significant Pretest X Practice interaction ($F = 6.25$; $df = 1,225$; $P < .01$) indicates that Group Practice was not equally beneficial to students of all ability levels. The within-treatment regression lines indicate that pupils in the Group Practice condition with low pretest scores on the SAT improved significantly more on the posttest than low achievers in the Individual Practice condition. The opposite was noted for high achieving students.

The situation is clarified further by the significant Pretest X Practice X Reward interaction ($F = 5.36$; $df = 1,224$; $P < .05$). The within-cell regression lines indicate that the Pretest X Practice interaction occurred only for the Individual Reward condition. The regression lines were parallel for the Team Reward condition. Thus contrary to expectation, Group Practice particularly benefited the low performers in the Individual Reward group. High performers in the Group Practice/Individual Reward condition improved significantly less than their counterparts in the Individual Practice/Individual Reward condition. No such trend was noted for participants in the Team Reward Group. Team members of all ability levels tended to improve slightly more in the Individual Practice condition.

Treatment Specific Attitudes

As expected, there were no treatment effects on Perceived Probability of Success. All pupils played the game under the same tournament conditions and high and low achievers did not perceive significant differences in their chances of winning the game. The average score for all subjects was 16.33, on a scale from five to twenty, indicating that pupils were optimistic about their chances of success.

The significant Reward main effect ($F = 5.44$; $df = 1,209$; $P < .05$) on Incentive Value of Success was due to the fact that pupils in the Team Competition group attached greater importance to winning the game than pupils in the Individual Competition group. The significant Practice main effect ($F = 4.77$; $df = 1,209$; $P < .05$) stemmed from the fact that participants in the Group Practice sessions had significantly lower scores on incentive value than those who practiced individually.

Team Competition had the most dramatic effect on the measure of normative climate in the classroom. Thirty-five percent of the variance in Peer Pressure scores was explained by reward level ($F = 119.25$; $df = 1,209$; $P < .01$). The difference in means is revealing. On a scale from four to sixteen with a neutral point at ten, students in the Individual Reward condition had an average score of 8.81 indicating the absence of peer pressure to do well at the game. Students in the Team Competition group had an average score of 11.95 indicating that these students believed their classmates had a positive interest in their academic success.

The significant SAT Pretest X Reward interaction ($F = 5.26$; $df = 1,209$; $P < .05$) for Game Satisfaction was due to the fact that low performers enjoyed the math game significantly more when they played as representatives of a team

rather than as isolated individuals even though team competition was associated with a higher level of peer pressure. Students with high pretest scores on the SAT enjoyed the game significantly more when they were in the Individual Competition group.

Note that satisfaction with the game was very high for all students. On a scale from five to twenty with a neutral point at 12.5, the average satisfaction score was 16.37.

Discussion

The purpose of the present study was to assess the effects on academic achievement of two components of the Teams-Games-Tournament technique: team competition and peer group practice sessions. Predictions concerning the effects of team competition were based on an expectancy value theory of motivation. As expected, students in the Team Competition group attached greater importance to winning the game than students in the Individual Reward group. Students in the Team condition also improved significantly more on the SAT than students in the Individual Reward group. This result is consistent with an expectancy value theory of motivation. It is also consistent with Coleman's hypothesis (1959) that peer group support for academic goals will foster the attainment of those goals. On the measure of normative climate in the classroom, students in the Team Competition group indicated that existence of peer pressure to do well at the game whereas students in the Individual Reward group indicated the absence of such pressure.

The predicted effect of Group Practice on academic achievement did not occur. Although peer tutoring sessions were designed to provide pupils with an additional mode of instruction, the results of the study suggest that Group Practice is not uniformly successful. Low performers in the Individual Reward condition benefited from the group practice session, but they did so at the expense of the high performer. Group practice had no

significant effect on the level of achievement of either high or low performers in the Team Competition group. It would appear that reward interdependence is not conducive to effective peer tutoring as it is structured in the TGT technique. Tutors and tutees are not designated. Although pupils have particular assignments to complete, they are not taught how to help each other. Students in the Team Reward group may be motivated to help one another, but they are not provided an efficient means to do so. On the other hand, students in the Individual Reward/ Group Practice condition did not have the expectation that teammates would help them with classwork assignments. The more casual contacts among seatmates not tied by reward interdependence may have provided the low performer in the Individual Reward condition with precisely the environment he needed in order to learn from his classmates.

Peer group practice sessions were expected to have an instructional effect rather than a motivational effect. Consequently, no hypotheses were formed concerning the effect of Practice on probability of success, incentive value of success or peer pressure. However, the results of the data analysis indicate that peer group practice had a negative effect on incentive value of success. That is, pupils in the Group Practice condition assigned a lower incentive value to game success than students in the Individual Practice condition. Recall that students in the Group Practice condition had frequent contacts with their peers. As a result, the interpersonal rewards accompanying game success may not have been as important to them as it was to students in the Individual Practice condition whose main contact with peers occurred only during the game-playing session. In addition, the group practice session may have provided a forum for students to develop norms minimizing the status effect of game success.

In terms of an expectancy value theory of motivation, the observed positive effect of Team Reward on incentive value of success and the observed negative effect of Group Practice would suggest the occurrence of similar treatment effects on student achievement. A positive Reward effect on math achievement was obtained; a negative Practice effect was not. However, some support for the theory is provided by the significant Pretest X Practice X Reward interaction. It indicated a negative effect on rates of improvement on the SAT by high achieving students in the Individual Reward/Group Practice condition as compared to the Individual Practice condition. There was also a tendency for students in the Team Reward/Group Practice condition to show less improvement on the SAT than their counterparts in the Individual Practice condition. The hypothesis was not confirmed for low achieving students in the Individual Reward group. Their performance dramatically improved in the Group Practice condition as compared to the Individual Practice condition. It had been assumed that pupils in the Individual Reward/Group Practice condition would not peer tutor potential game competitors. However, if students in the Group Practice condition do not consider winning the game to be important (as evidenced by their lower scores on incentive value of success), then they may be more willing to help each other than expected.

Significance

The results of this study suggest that the non-simulation game can be an effective instructional device for increasing student academic achievement. Its success as an instructional aid depends upon the reward system and the practice structure under which students operate as well as

the relevance of the game to curriculum goals. As the present study has shown, the same game may be played under two different reward systems (Team Competition vs. Individual Competition), and the effects on student attitudes and student achievement will be significantly different.

Advocates of the use of games in the classroom have traditionally focused their attention on the attributes of the games themselves, e.g., the importance of strategy to winning the game, the size of the game-playing group, the number of "moves" a player is able to make (cf. Boocock & Schild, 1968). The results of the present study suggest that the reward and practice structures are as important as the internal structure of the game. The relevance of expectancy value theory to the design of game structures has been demonstrated. In order for games to serve as facilitators in the learning process, game success must be tied to an incentive system which motivates the student to learn the skills necessary for winning and provides the opportunity to do so.

Table 1--Summary of Results of Regression Analysis for 2 X 2 Design

Dependent Variables	Independent Variables							
	SAT Pretest (A)	Class Ability	Reward (B)	Practice (C)	A X B	A X C	B X C	A X B X C
Achievement								
SAT Grade Equivalent	.01	.01	.05	--	--	.01	--	.05
Treatment Specific Attitudes								
Perceived Probability of Success	--	--	--	--	--	--	--	--
Incentive Value of Success	--	--	.05	.05	--	--	--	--
Peer Pressure for Success at Game	--	--	.01	--	--	--	--	--
Satisfaction	--	--	--	--	.05	--	--	--

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